The Economic Relevancy of Risk Preferences Elicited Online and With Low Stakes

John Gibson and David Johnson

Georgia State University, University of Central Missouri

8 June 2018

The Economic Relevancy of Risk Preferences Elicited Online and With Low Stakes

John Gibson[*]
Georgia State University

David Johnson[†]
University of Central Missouri

April 11, 2018

Abstract

We explore the relevancy of subjects' risk preferences recovered using a subjective risk question to those recovered from the incentivized lottery experiments of Holt and Laury (2002), Gneezy and Potters (1997), and Johnson and Webb (2016). While a statistically significant relationship between subjective and incentivized risk measures has been documented, existing papers utilize laboratory (or lab-in-field) experiments with moderately large stakes. We investigate whether this relationship is preserved in an online environment with small stakes. Our results are consistent with the previous literature, suggesting that the correlation between subjective and incentivized risk measures is preserved online and with small stakes.

JEL classification: C99, C83, D81
Key Words: Subjective Risk Preferences; Incentivized Risk Measures; Online Experiments

[*]Department of Economics, Georgia State University, Atlanta, GA 30303, U.S.A. Telephone: 1-404-413-0202. Email: jgibson25@gsu.edu

[†]Department of Economics and Finance, University of Central Missouri, Warrensburg, MO 64093, U.S.A. Telephone: 1-336-639-2190. Email: djohnson@ucmo.edu

1 Introduction

Recently, there has been an increase in the amount of economic research conducted using online environments such as Amazon Mechanical Turk (c.f., Keith et al., 2017). A researcher's decision to utilize an online environment is often motivated by the need to gather a large number of observations from a heterogeneous population at a relatively low cost (c.f., Ipeirotis, 2010).[1] However, one may question the validity of online experiments due to the potential loss of control and low stakes which may reduce the saliency of incentives. Therefore, research is needed to establish whether online environments, especially those with low stakes, are capable of producing economically meaningful data.

We investigate the relevancy of subjects' risk preferences in an online experiment conducted via Amazon Mechanical Turk (AMT) under low stakes using the German Socio-Economic Panel Survey (SOEP) subjective risk question (popularized by Dohmen et al., 2011), and the incentivized lottery experiments of Holt and Laury (2002), Gneezy and Potters (1997), and Johnson and Webb (2016). Consistent with previous literature we find subjects make decisions suggesting risk averse preferences. Further, we document a statistically significant relationship between subjective and incentivized risk measures, in an online setting with low stakes, that is similar to that found using traditional laboratory (or lab-in-field) environments under moderately large stakes (see Dohmen et al., 2011; Anderson and Mellor, 2009). Therefore, our results echo the primary findings of Dohmen et al. (2011).[2] It is important to note that we achieve this consistency while spending a little more than $300 on the entire experiment.

Our contribution to the literature is three-fold. First, we provide additional evidence regarding the behavioral relevance of subjective risk preferences, thereby providing support for researchers who rely on such measures.[3] Secondly, given that the findings of our online experiment mirror that of studies conducted using

[1] Conducting economic experiments in a traditional laboratory is expensive, and often requires average subject payments in excess of $20. Consequently, researchers considering designs requiring a large number of observations, or those operating on tight budgets, may view online experiments as a sensible, low cost alternative.

[2] With our data, we can qualitatively match additional results from Dohmen et al. (2011) (e.g., the relationship between domain specific risk preferences and actual risky behavior). To maintain focus however, we limit our analysis to the relationship between subjective risk preferences and decisions in incentivized lottery experiments.

[3] Subjective risk questions may be preferred if one is concerned with portfolio effects, or if the research budget is not sufficient to cover additional incentivized activities.

traditional laboratory methods, we provide evidence supporting the relevancy of online experiments in economic research. Other works (c.f., Horton et al., 2011; Amir et al., 2012) also document the similarity of results in online and laboratory experiments. We extend this work to the area of risk preferences - particularly the link between subjective and incentivized risk measures. Last, we observe a significant proportion of our subjects making decisions that are inconsistent with standard economic theory. We demonstrate that while basic demographic characteristics, such as age and gender, are uncorrelated with inconsistent behavior, subjects' level of impulsiveness, as measured by the Barrett Impulsiveness Test, is a significant predictor of such behavior.

The remainder of the paper is organized as follows. Sections 2 and 3 present our experimental design and hypothesis respectively, while Section 4 describes our results. Section 5 concludes and provides a brief discussion of future research.

2 Design

We study the behavioral relevance of subjective risk preferences using an online experiment. The experiment takes place online using Amazon Mechanical Turk (AMT). AMT is an online labor market made up of requestors (the experimentors) and workers (the subjects). Requestors post Human Intelligence Tasks (HITs) on AMT that are completed by the workers. These HITs are analogous to experimental sessions in the lab. Workers are paid a flat fee for completing a HIT and may earn a bonus at the discretion of the requestor. The bonus mechanism is how we pay workers for their decisions.

The experiment has multiple stages. After indicating consent, subjects start the first stage where they complete a survey and two Holt Laury (HL) risk aversion tests. In the HL risk aversion test, subjects are shown a menu of 10 paired lotteries. Lotteries on the left hand side are safer and have a smaller variance ($2.00 and $1.60); lotteries on the right hand side are riskier and have a larger variance ($3.85 and $0.10). Lotteries become more favorable to the subject as she moves down the menu ($2.00 and $3.85 become more likely). Subjects are told to indicate which lottery they prefer for each pair (i.e., the left and right column) using radio buttons. Subjects are paid based upon their choice of lotteries in one of the ten lottery pairs, selected at random. We consider two HL tests. The first HL test (HL_N) pays the base-line amounts from Holt and Laury (2002) (i.e., $2.00, $1.60, $3.85, and $0.10), and the second HL test (HL_L) pays 1/5 the HL_N payments. After completing the HL tests, subjects move to the second stage to complete another survey that includes basic demographic questions, the Barratt Impulsiveness Scale (Barratt et al., 1975), and the SOEP risk questions.[4]

After completing the SOEP questions, subjects move to the final stage and complete two more tests to measure their risk preferences with real stakes. The first of these tests, INV, is the investment risk elicitation test developed in Gneezy and Potters (1997), and used recently in Agranov and Ortoleva (2017). In this test, subjects are endowed \$1.00 and are allowed to invest any portion of it in a risky option. Subjects are told that if the investment is successful they will earn 2.5 times the amount they invested plus the amount they did not invest. Subjects are also told that the investment will be successful with 50 percent probability. Unlike in our previous tests, where subjects indicate their choices using radio buttons, subjects now indicate the amount they wish to invest by inputing a number into a text box. This distinction is important as one informal criticism of AMT is that subjects may input responses in a near random fashion. Therefore, by varying the nature of inputs across incentivized risk aversion tests we can, at least to some extent, account for this potential issue. This point is discussed further below.

The final incentivized risk aversion test, JW, is the lottery selection task introduced in Johnson and Webb (2016). In this test, subjects are asked to select a single lottery to play for real stakes from a set of 20 lotteries. The lotteries range from a 5% chance to win \$5 to a 100% chance to win \$0.25.[5] In the analysis, each of the lotteries is assigned an index number.[6] Lotteries with a lower index number are risker, but offer a large payoff if favorable, while those with a higher index number are safer, but offer a lower payoff if favorable. Subjects indicate the lottery they wish to play by clicking on a radio button that corresponds to one of the 20 lotteries. Once the final tests are completed, subjects are told their earnings and submit their data. Subjects participate only once (verified with their unique AMT worker ID) and are paid within two days of the experiment.

We focus on subjects' responses to HL_N, HL_L, INV, JW, and the general risk question from the German Socio-Economic Panel ($RISK_G$). This question is worded as follows:

[4] All of the questions are found in the Appendix.
[5] See Appendix for a full list of these lotteries.
[6] However, in the experiment, lotteries are assigned a letter of the alphabet.

How do you see yourself: Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?

Subjects answer this question on an 11 point scale ranging from 0 to 10 - with 0 corresponding to "I avoid risk" and 10 corresponding to "Fully prepared to take risks." We choose this risk question to gain comparability with Dohmen et al. (2011), who document a strong relationship between subjects' response to this question and their choices in an incentivized lottery experiment. However, while our study is conducted online under low stakes, the experiment in Dohmen et al. (2011) is conducted in subjects' homes with incentivized earnings up to €300.00.

We purposely have subjects participate in many lottery experiments. This design choice was made to demonstrate that subjects are not randomly inputing text and are instead providing economically meaningful data. For instance, if subjects are providing economically meaningful data, then we should observe an inverse relationship between our subjects' reported general willingness to take risk, RISK_G, and both the number of safe lotteries selected in the HL tests and the index number of lotteries selected in the JW test. We should also observe a positive relationship between RISK_G and the amount subjects invest in the INV test. While consistency between agents' subjective risk preferences and their behavior in a single incentivized test could happen by chance, it is unlikely to happen across all of the tests - which have subjects enter answers in different ways: text, columns of radio buttons, and a row of radio buttons.

Lastly, we open our experiment to all workers on AMT, regardless of their education level, country of origin, or their "reputation" on AMT.[7] This choice was made simply to ensure that we consider the broadest sample possible.

3 Hypotheses

We base our hypotheses off the findings of the previous literature. Thus, the implicit null hypothesis is that subjects in the online environment, with low stakes, behave in a manner similar to subjects participating in a traditional laboratory experiment under significantly larger stakes.

[7] AMT workers gain "reputation" through the feedback they receive from previous requestors. While we do not provide negative feedback on our participants, many requestors operating outside of academia certainly do. As such, it is possible to restrict participation based on workers' accumulated feedback or "reputation."

Hypothesis 1 *Subjects will make choices that are consistent with risk averse preferences in the incentivized lottery experiments.*

In Holt and Laury (2002), Gneezy and Potters (1997), and Johnson and Webb (2016) subjects make choices that suggest a moderate degree of risk averse or loss averse preferences. We expect to observe similar results in our experiment: the number of safe choices selected by subjects in both of the HL tests will be significantly greater than four, the amount subjects invest in the INV test to be significantly less than $1.00, and the average index number of the lottery selected by subjects in the JW test to be greater than 10.

Hypothesis 2 *Risk Aversion will be increasing in stake size.*

Holt and Laury (2002) observe that subjects behave in a more risk averse manner as stake size increases. We expect to observe similar effects in our experiment and predict that the average number of safe choices selected in the HL_N test will be greater than the number of safe choices in the HL_L test.

Hypothesis 3 *Subjects' willingness to take risks in the incentivized experiments correlates with their self-reported subjective risk preference.*

As mentioned in the introduction, previous literature documents an economically meaningful relationship between subjective risk preferences and choices made in incentivized economic experiments. Generally speaking, subjects who indicate they are more willing to take risk, make riskier choices (c.f., Dohmen et al., 2011; Johnson and Webb, 2016). We expect to find a similar relationship in our experiment. Subjects who indicate that they are more willing to take risk will select significantly fewer safe choices in the HL tests, select a lottery with a significantly lower index number in the JW test, and invest a larger amount in the INV test than subjects who report being less willing to take risk.

Hypothesis 4 *Subjects with higher Barratt Impulsiveness Test scores will be more likely to make inconsistent choices in the HL tests.*

The Barratt Impulsiveness test measures the impulsiveness personality construct and is a commonly used tool in the Psychology literature. Higher Impulsiveness Test scores correspond to greater levels of impulsiveness. Given the complexity of the HL tests relative to the other incentivized risk aversion tests, we hypothesize that subjects with higher Impulsiveness Test scores will be more likely to make inconsistent choices in HL tests (i.e., have multiple switch points or select only safe choices) than subjects who are less impulsive. We base this hypotheses off of Gibson and Johnson (2017) who find that subjects who report to be less attentive (one of the factors of the Impulsiveness Test) are less likely to respond to incentives in a simple lottery-like decision task.

4 Results

75 subjects participate in the experiment. On average, subjects spend 18 and a half minutes on the experiment and earn \$4.39 (plus \$0.25 participation fee). Table 1 presents summary statistics for the variables of interest. Variable descriptions are as follows: FEMALE is a dummy variable equal to one if the subject is female; AGE is reported age; SHL_N (SHL_L) is the number of safe choices selected in the HL_N (HL_L) test; AINV is the amount invested (US cents) in the INV test; LJW is the index number of the lottery selected by subjects in the JW test; RISK_G is the response to the general risk question from the SOEP; and IMP corresponds to Impulsiveness Test scores.

Of our 75 subjects, 33 can be classified as making inconsistent choices on at least one of the two HL tests. Specifically, these 33 subjects either; (i) choose all safe lotteries even though the final risky lottery is strictly better, or (ii) switch between safe and risky choices multiple times. While such inconsistent behavior is expected in an experimental setting, the extent to which it is observed in our sample is likely a result of the limited restrictions put in place regarding our subject pool. To account for this, we conduct our primary analysis using both our full sample, as well as a restricted subsample which removes the 33 subjects. We find that our results are consistent in terms of sign and significance, and mostly consistent in terms of magnitude, across the two samples. Furthermore, we find that subjects' Impulsiveness Test score is a significant predictor of inconsistent behavior.

The distributions of subjects' responses, in our full sample, to each of the incentivized tests, general willingness to take risk, and Impulsiveness Test scores are found in Figure 1. Here we first note that it appears that subjects are not randomly inputting text. If so, we would expect the distributions of SHL_N, SHL_L, and LJW to all be relatively flat (i.e., a uniform distribution) - which they are not. The average

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
FEMALE	0.35	0.48	0	1
AGE	33.4	9.72	21	68
RISK_G	4.75	2.86	0	10
SHL_N	7.21	2.42	0	10
SHL_L	6.48	2.60	0	10
AINV	51.49	34.77	0	100
LJW	12.25	4.74	1	20
IMP	61.71	12.91	38	87

Notes: Summary statistics of the main variables of interest. $n = 75$.

RISK_G response is 4.75, which is nearly identical to the 4.76 reported in Dohmen et al. (2011). However, the distribution we observe is, visually, quite different than what is observed in Dohmen et al. (2011). While subjects' choices in HL_N, HL_L, and JW appear to be non-uniform, subjects' responses on the general risk attitudes questions, RISK_G, appears much closer to uniform (see Table 1). However, as discussed further below, we still observe a strong relationship with the predicted sign between RISK_G and all incentivized tests.

Result 1 *In all four lottery experiments, subjects' make choices consistent with risk aversion.*

We find evidence in support of Hypotheses 1. Like subjects in the lab, subjects participating in our online experiment are, on average, risk averse. Subjects select an average of 7.21(6.48) safe lotteries in HL_N (HL_L) - both of which are significantly greater than 4 or the number of safe lotteries that would be chosen by a risk neutral subject (t-test: $p < 0.001$ for both).[8] Further, evidence in support of risk averse preferences is found when we examine the average lottery index number selected and amounts invested by subjects in the JW and INV tests. In JW, the average

[8] The average number of safe choices in our experiment is higher than that reported by Holt and Laury (2002). This is predominately driven by a relatively large fraction of our subjects choosing all safe choices. While somewhat worrisome, it is probably less so when we consider the differences in the demographics of the two samples. Most notably, roughly half of the sample that participated in Holt and Laury (2002) were either MBA students or faculty members. In our sample, only 16 percent of subjects report to have a graduate degree. Moreover, subjects in Holt and Laury (2002) had the opportunity to ask questions during the experiment. While subjects in our experiment also had that opportunity, doing so required sending an email and is therefore quite costly for them.

lottery index number is 12.25 which is significantly greater than lottery ten and eleven, which offer the same expected utility under risk neutrality (t-test: $p < 0.001$ & $p = 0.012$). The average amount invested (51.49) is also significantly less than 100 cents (t-test: $p < 0.001$).

Result 2 *Risk aversion is increasing in stake size.*

We find evidence in support of Hypothesis 2, subjects select fewer safe lotteries in HL_L relative to HL_N (t-test: $p = 0.004$). The fact that the average number of safe lotteries chosen falls with stake size is consistent with the findings of Holt and Laury (2002).[9]

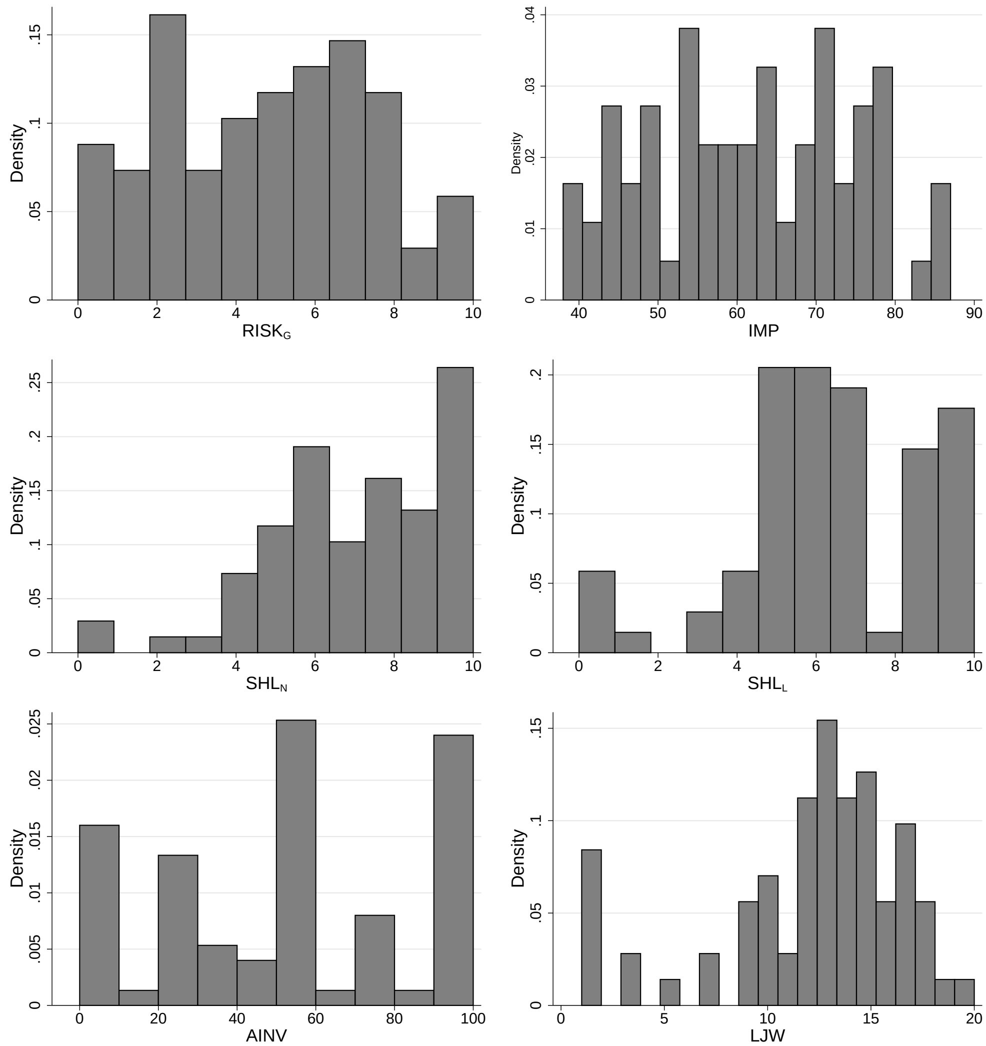
Result 3 *Subjects who report to be more willing to take risk make riskier choices in all four of the incentivized lottery experiments.*

In Figure 2, we present a scatter plot of subjects' RISK_G against their choices in each of the four experiments. As predicted under Hypothesis 3, RISK_G scores are significantly negatively correlated with SHL_L ($r = -0.208$; $p < 0.001$), SHL_N ($r = -0.398$; $p < 0.001$), LJW ($r = -0.443$; $p < 0.001$), and positively correlated with AINV ($r = 0.359$; $p = 0.002$). Further, when we use OLS, with robust standard errors, to estimate subjects' choices in each of the four incentivized tests, using RISK_G as the independent variable, we find RISK_G is always statistically significant and in the direction one would expect (SHL_N: *coef*=-0.338, $p < 0.001$; SHL_L: *coef*= -0.188, $p = 0.044$; AINV: *coef*= 4.370, $p = 0.001$; LJW: *coef*= -0.734, $p < 0.001$). Given that larger numbers in the HL tests and JW experiment correspond to greater risk aversion and larger amounts invested in the INV test the opposite, these correlations suggest that subjects who report to be less (more) willing to take risk make safer (riskier) choices when real stakes are involved - even when the stakes are low.

While the regressions discussed above are suggestive, OLS is not the preferred estimator for JW and HL tests due to the structure of the dependent variables. For a more complete understanding of the link between subjective risk preferences and observed behavior in the HL and JW tests, we now consider an ordered probit. Table 2 presents results from six ordered probits estimating the number of safe choices selected by subjects in both HL tests (Models 1 through 4) and the index

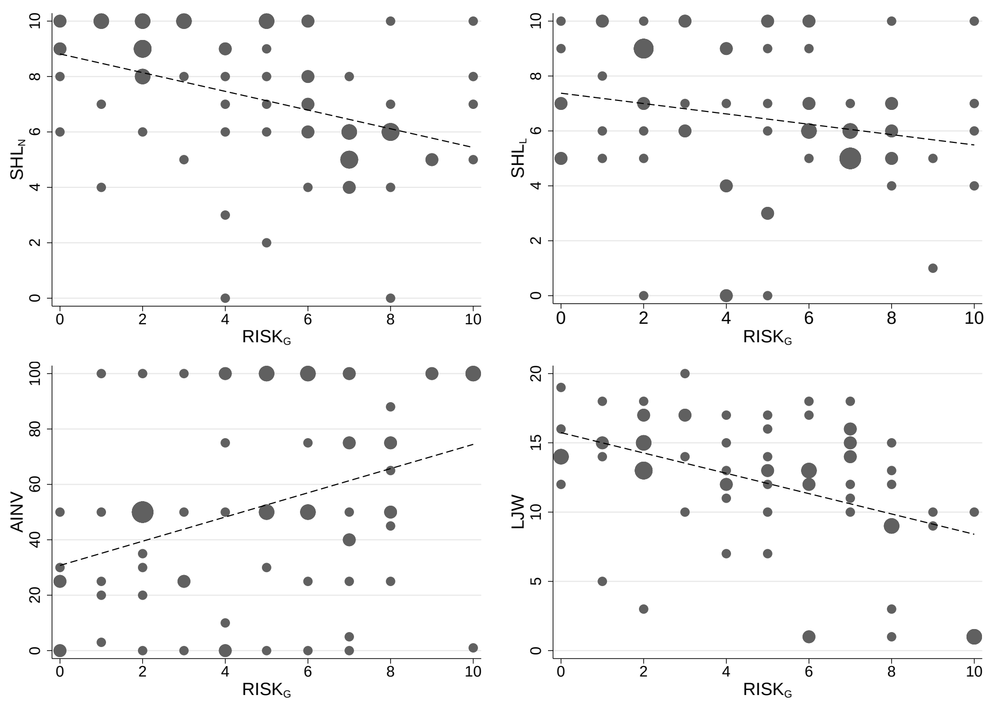
[9] While we had no prior, we also find that subjects' choices in the two HL tests are highly correlated ($r = 0.581$; $p < 0.001$) - suggesting some stability of individual risk preferences.

Figure 1: Distribution of RISK$_G$, IMP, SHL$_N$, SHL$_L$, AINV and LJW



Notes: Distribution of general willingness to take risk, Impulsiveness Test scores, the number of safe lotteries selected in the two Holt Laury experiments, the amount invested in the INV test and the index number selected by subjects in the lottery selection experiment.

Figure 2: Scatter Plot of RISK_G against SHL_N, SHL_L, AINV and LJW



Notes: Scatter plot of subjective risk preferences against subjects' choices in the HL, INV, and JW tests. Dashed line corresponds to a least squares regression line. All coefficients on RISK_G are significantly different than zero.

number of the lottery they selected in JW test for both our full (A) and restricted (B) samples.[10] Models 1, 3, and 5 only control for subjects' RISK_G score, while Models 2, 4, and 6 include additional demographic controls. Inspection of Table 2 indicates a negative and statistically significant relationship between subjects' willingness to take risk and their choices in each of the three tests. Therefore, we show that an increase in subjects' reported willingness to take risks results in a statistically significant reduction in the number of safe choices selected in the HL tests as well as the index number of the lottery selected in the JW test. Furthermore, the sign and significance of our point estimates is found to be robust across the full and restricted samples.[11]

Result 4 *Subjects who make inconsistent decisions in the HL tests have significantly greater Impulsiveness Test scores than those who make consistent choices.*

The average Impulsiveness Test score for subjects who had more than one switch point in one of the HL tests is 70.6 ($n = 15$) and is greater than the average Impulsiveness Test score ($59.48, n = 60$) of subjects who only had a single (or no) switch point. This difference is statistically significant (t-test: $p = 0.002$; U-test: $p = 0.003$). Similar results are observed if we also include subjects who selected all safe choices in at least one of the HL tests. As mentioned above, 33 of our subjects make such inconsistent choices in at least one of HL tasks. The average Impulsiveness Test score for these subjects is 66.03 while the average Impulsiveness Test score for subjects who made consistent choices is 58.31. This difference is statistically significant (t-test: $p = 0.009$; U-test: $p = 0.016$).

Interestingly, there is no evidence that inconsistent choices are explained by standard demographics. This can be seen in Table 3 which presents the results of four probits that estimate the probability an individual will have more than one switch point (Models 1 & 2) and have more than one switch or select all safe choices (Models 3 & 4) using Impulsiveness Test scores (IMP), RISK, MALE, and AGE as independent variables. In all of the results presented, only IMP is statistically

[10] Estimates using OLS, poisson, and tobit are available upon request. The results of these alternatives are not substantially different from what is presented here. While arguments for and against each of these alternative models exist, we choose to present ordered probit regression based off of feedback from an anonymous referee.

[11] Similar results are observed if we calculate subjects' CRRA preferences based off of their choices in each of the tests and use an interval regression to estimate the CRRA preferences as a function of their willingness to take risk. These results are not the motivation of the paper but are available upon request.

Table 2: Ordered Probit Results

A: All Subjects ($n = 75$)						
	1	2	3	4	5	6
	HL_N	HL_N	HL_L	HL_L	LJW	LJW
RISK_G	-0.161***	-0.198***	-0.078*	-0.099*	-0.181***	-0.176***
	(0.048)	(0.058)	(0.041)	(0.052)	(0.043)	(0.052)
Log. L	-146.071	-143.987	-149.551	-144.313	-182.597	-177.642
Controls		✓		✓		✓

B: Sub-Sample ($n = 42$)						
	1	2	3	4	5	6
	HL_N	HL_N	HL_L	HL_L	LJW	LJW
RISK_G	-0.134**	-0.294***	-0.128**	-.238***	-0.174***	-0.180**
	(0.061)	(0.086)	(0.053)	(0.068)	(0.063)	(0.082)
Log. L	-74.780	-67.725	-70.704	-64.076	-95.458	-93.630
Controls		✓		✓		✓

Notes: Decisions made in the HL and JW risk aversion tests. Dependent variable is the number of safe choices selected (models 1 through 4) or the index number of the selected lottery (models 5 and 6). Top set of models (A) use the full sample ($n = 75$). Bottom set (B) corresponds to the sub-sample that do not have inconsistent choices (i.e., multiple switch points) or select only safe choices in the HL test. RISK_G is subjects' response to the general willingness to take risk question ($n = 42$). ✓indicates the inclusion of age, gender, the natural log of income, and education as control variables. All models use robust standard errors. ***$p \leq .01$, **$p \leq .05$, and *$p \leq .1$.

significant - suggesting that inconsistent choices in the HL tests are being driven by the Impulsivity personality construct. Moreover, the effect of Impulsivity is not trivial as a one standard deviation increase in the Impulsiveness Test score is associated with a 10 percent increase in the probability the individual will make an inconsistent choice in at least one of the HL tests.

Table 3: Who Makes Inconsistent Choices?

	1	2	3	4
	Switch		Switch & Safe	
IMP	0.042***	0.037**	0.031***	0.034***
	(0.016)	(0.017)	(0.012)	(0.012)
$RISK_G$		0.093		-0.049
		(0.079)		(0.057)
MALE		-0.164		-0.023
		(0.418)		(0.332)
AGE		-0.005		0.001
		(0.018)		(0.016)
CONS	-3.572***	-3.427**	-2.083***	-2.042**
	(1.108)	(1.531)	(0.742)	(1.031)
Log. L	-32.834	-31.824	-47.973	-47.563

Notes: Probit results estimating the probability a subject will have multiple switch points in at least one of the HL tests (Models 1 and 2) and have multiple switch points or select only safe lotteries. All models use robust standard errors. ***$p \leq .01$, **$p \leq .05$, and *$p \leq .1$. $n = 75$.

5 Conclusion

We find subjects participating in our online experiment are generally risk averse and make choices across subjective and incentivized risk questions in a consistent manner. Our findings echo that of the current literature. However, while existing papers utilize traditional laboratory (or lab-in-field) experiments under moderately large stakes, our paper demonstrates that these findings are robust to online environments and low stakes. Therefore, along with providing further evidence in support of the behavioral relevance of subjective risk measures, our paper contributes to the growing literature demonstrating the quality of results found using online samples (c.f., Horton et al., 2011; Amir et al., 2012; Hauser and Schwarz, 2016). This finding may be driven by reputation effects which operate more often online, or because relative, rather than absolute, payment size matters more when subjects are assessing the relevancy of payments.[12&13] However, additional research is needed to conclusively make this case.

References

Agranov, Marina, and Pietro Ortoleva (2017) 'Stochastic choice and preferences for randomization.' *Journal of Political Economy* 125(1), 40–68

Amir, Ofra, David G Rand, and Kobi Gal (2012) 'Economic Games on the Internet: The Effect of $1 Stakes.' *PloS one* 7(2), e31461

Anderson, Lisa R, and Jennifer M Mellor (2009) 'Are risk preferences stable? comparing an experimental measure with a validated survey-based measure.' *Journal of Risk and Uncertainty* 39(2), 137–160

Barratt, Ernest S, J Patton, and M Stanford (1975) *Barratt Impulsiveness Scale* (Barratt-Psychiatry Medical Branch, University of Texas)

Dohmen, Thomas, Armin Falk, David Huffman, Uwe Sunde, Jürgen Schupp, and Gert G Wagner (2011) 'Individual Risk Attitudes: Measurement, Determinants, and Behavioral Consequences.' *Journal of the European Economic Association* 9(3), 522–550.

Gibson, John, and David Johnson (2017) 'Why Bother? Understanding the Impact of Financial Obligations on Wage Selectivity.' Technical Report, University Library of Munich, Germany

Gneezy, Uri, and Jan Potters (1997) 'An experiment on risk taking and evaluation periods.' *The Quarterly Journal of Economics* 112(2), 631–645

Hauser, David J, and Norbert Schwarz (2016) 'Attentive turkers: Mturk participants perform better on online attention checks than do subject pool participants.' *Behavior research methods* 48(1), 400–407.

[12] While we do not punish our subjects, other requestors on AMT do. If a worker receives sufficiently negative feedback, they will loose access to jobs on AMT. As such, AMT subjects have an additional incentive to perform well relative to traditional lab subjects.

[13] While our $4.39 average payment is extremely low for a traditional laboratory experiment, it is quite high for AMT. Furthermore, experiments conducted online are less burdensome on subjects (shorter, conducted anywhere, flexibility in time, etc), and as such may require smaller payments.

Holt, Charles A, and Susan K Laury (2002) 'Risk aversion and incentive effects.' *American economic review* 92(5), 1644–1655.

Horton, John J, David G Rand, and Richard J Zeckhauser (2011) 'The Online Laboratory: Conducting Experiments in a Real Labor Market.' *Experimental Economics* 14(3), 399–425

Ipeirotis, Panagiotis G (2010) 'Demographics of Mechanical turk.'

Johnson, David B, and Matthew D Webb (2016) 'Decision Making with Risky, Rival Outcomes: Theory and Evidence.' Technical Report, Carleton University, Department of Economics

Keith, Melissa G, Louis Tay, and Peter D Harms (2017) 'Systems perspective of amazon mechanical turk for organizational research: Review and recommendations.' *Frontiers in psychology* 8, 1359

A Instructions

A.1 Consent

This research is being conducted by Dr. XXXX and Dr. XXXX who are professors at the XXXX and XXXX, respectively.

I choose to voluntarily participate in this research study. I have been recruited for this study through Amazon Mechanical Turk. Only persons 18 years of age or older may participate. I affirm that I am 18 years of age or older. Only individuals who read and write English may participate. I affirm that I can read and write in English. This study has been approved by the University of XXXX.

This HIT involves completing an experiment that will measure your risk preferences and completing a demographic survey. The HIT should take no more than 10 minutes and will pay a bonus that will depend on your decisions and random chance (like the flip of a coin).

I am free to withdraw from the study at any time without incurring the ill will of the researchers. If I withdraw, my data will not be used and will be deleted by the researchers as early as possible. If I wish to withdraw, I must do so within 20 days of completing the study. There are no known risks or benefits from this study beyond those from any typical activity I might do in an online environment. This study will benefit society by helping researchers better understand how individuals respond to risk. The confidentiality of any personal information will be protected to the extent allowed by law.

My name or AMT account number will not be reported with any results related to this research. I can obtain further information from Dr. XXXX (XXXX). If I have any questions about this study, I can contact Dr. XXXX at XXXX.edu. If I have any questions about my rights as a participant, I should contact the Human Subjects Protection Program at (XXX-XXX-XXXX). I may ask questions at any time via email (XXXX).

Should new information become available during the course of this study, about risks or benefits that might affect my willingness to continue in this research project, it will be given to me as soon as possible.

By clicking on the start button below, I am indicating my consent to participate in this study.

If you do not wish to participate, please return the HIT.

A.2 Survey 1

Before we begin, please answer the following questions.

Do you or anyone in your primary household own any stocks, shares, or other stock options?

- No
- Yes

Do you participate in any sports (at least once per month)?

- No
- Yes

Are you currently self-employed?

- No
- Yes

Are you a tobacco user?

- No
- Yes

What is your age?

What is your height?

- Feet
- Inches

What is the total yearly income of your household (in US dollars)?

Including yourself, how many adults are in your household?

Which of the following best describes your highest achieved education level?

- Some High School

- High School Graduate
- Some college, no degree
- Associates degree
- Bachelors degree
- Graduate degree (Masters, Doctorate, etc.)

Which of the following best describes your parent's highest achieved education level?

- Some High School
- High School Graduate
- Some college, no degree
- Associates degree
- Bachelors degree
- Graduate degree (Masters, Doctorate, etc.)

A.3 Holt Instructions 1

Shortly, you will see a decision screen that is an example of what you will see when you make your actual decisions. You will see two of these decision screens in this experiment. Each decision screen will show ten decisions listed. Each decision is a paired choice between "Option A" and "Option B." For each decision screen, you will make ten choices and record these in the relevant column using radio buttons. However, only one choice will be used in the end to determine your earnings for each screen (i.e., one for each decision screen). Before you start making your ten choices, please let us explain how these choices will affect your bonus for the experiment.

After you have made all of your choices, a random number generator will determine your bonus. The random number generator will randomly select two pairs of integers between 1 and 10 (inclusive). Each number is equally likely to be chosen by the computer and can be chosen more than once (think of it like rolling a ten sided dice 4 times).

Two pairs of numbers will be generated, one for each decision screen. The first number in each pair will determine which of the ten decisions will be used to determine your bonus. The second number in each pair will determine what your bonus is for the choice you made, A or B. Your total bonus will include the bonus earned on BOTH decision screens.

NOTE: This means for each decision screen, even though you will make ten decisions, only one will end up affecting your bonus, but you will not know in advance which decision will be used. Each decision has an equal chance of being used in the end.

You will not be told your payoffs until after you have completed the HIT.

A.4 Holt Instructions 2

An example of the decision screens you will see is shown below. While the decision screen shown below is similar to the decision screens you will use to make your choices, the numbers on the screen that you will use to make your choices will be different.

To start, please look at Decision 1 at the top. Option A pays 1.20 dollars if the second randomly generated number is 1, and it pays 0.96 dollars if the second randomly generated number is between 2 and 10. Option B yields 2.31 dollars if the randomly generated number is 1, and it pays 0.06 dollars if the randomly generated number is between 2 and 10. The other Decisions are similar, except that as you move down the table, the chances of the higher payment for each option increase. In fact, for Decision 10 in the bottom row, the random number generator will not be needed since each option pays the highest payoff for sure, so your choice here is between 1.20 dollars or 2.31 dollars.

The decision that would be used to determine your actual bonus is assigned by the first randomly generated number. Therefore, if the first randomly generated number is 2 and the second randomly generated number is 3, Decision 2 would be used to determine your payoff. If you selected Option A for Decision 2, you would therefore earn 0.96 dollars. If you selected Option B for Decision 2, you would earn 0.06 dollars.

To summarize, you will make two pairs of ten choices: for each Decision you will have to choose between Option A and Option B. You may choose A for some Decisions and B for others. You may change your decisions and make them in any order.

For your convenience, one of your decision screens has been named “GREEN” and the other has been named “RED.” You will be paid a bonus equal to your

Decision	Option A	Option B
1	1/10 of $1.20, 9/10 of $0.96	1/10 of $2.31, 9/10 of $0.06
2	2/10 of $1.20, 8/10 of $0.96	2/10 of $2.31, 8/10 of $0.06
3	3/10 of $1.20, 7/10 of $0.96	3/10 of $2.31, 7/10 of $0.06
4	4/10 of $1.20, 6/10 of $0.96	4/10 of $2.31, 6/10 of $0.06
5	5/10 of $1.20, 5/10 of $0.96	5/10 of $2.31, 5/10 of $0.06
6	6/10 of $1.20, 4/10 of $0.96	6/10 of $2.31, 4/10 of $0.06
7	7/10 of $1.20, 3/10 of $0.96	7/10 of $2.31, 3/10 of $0.06
8	8/10 of $1.20, 2/10 of $0.96	8/10 of $2.31, 2/10 of $0.06
9	9/10 of $1.20, 1/10 of $0.96	9/10 of $2.31, 1/10 of $0.06
10	10/10 of $1.20, 0/10 of $0.96	10/10 of $2.31, 0/10 of $0.06

payoff from the GREEN decision screen plus the payoff from the RED decision screen. Earnings (in pennies) for this choice will be paid using the AMT bonus mechanism. Please click the NEXT button to continue.

A.5 Holt and Laury 1

GREEN DECISION SCREEN: Please look at the empty radio buttons in each column. You will use these radio buttons to make your decision (A or B). When you have made all of your decisions, please click the NEXT button.

Decision	Option A	Option B
1	1/10 of $2.00, 9/10 of $1.60	1/10 of $3.85, 9/10 of $0.10
2	2/10 of $2.00, 8/10 of $1.60	2/10 of $3.85, 8/10 of $0.10
3	3/10 of $2.00, 7/10 of $1.60	3/10 of $3.85, 7/10 of $0.10
4	4/10 of $2.00, 6/10 of $1.60	4/10 of $3.85, 6/10 of $0.10
5	5/10 of $2.00, 5/10 of $1.60	5/10 of $3.85, 5/10 of $0.10
6	6/10 of $2.00, 4/10 of $1.60	6/10 of $3.85, 4/10 of $0.10
7	7/10 of $2.00, 3/10 of $1.60	7/10 of $3.85, 3/10 of $0.10
8	8/10 of $2.00, 2/10 of $1.60	8/10 of $3.85, 2/10 of $0.10
9	9/10 of $2.00, 1/10 of $1.60	9/10 of $3.85, 1/10 of $0.10
10	10/10 of $2.00, 0/10 of $1.60	10/10 of $3.85, 0/10 of $0.10

A.6 Holt and Laury 2

RED DECISION SCREEN: Please look at the empty radio buttons in each column. You will use these radio buttons to make your decision (A or B). When you have made all of your decisions, please click the NEXT button.

Decision	Option A	Option B
1	1/10 of \$0.40, 9/10 of \$0.32	1/10 of \$0.77, 9/10 of \$0.02
2	2/10 of \$0.40, 8/10 of \$0.32	2/10 of \$0.77, 8/10 of \$0.02
3	3/10 of \$0.40, 7/10 of \$0.32	3/10 of \$0.77, 7/10 of \$0.02
4	4/10 of \$0.40, 6/10 of \$0.32	4/10 of \$0.77, 6/10 of \$0.02
5	5/10 of \$0.40, 5/10 of \$0.32	5/10 of \$0.77, 5/10 of \$0.02
6	6/10 of \$0.40, 4/10 of \$0.32	6/10 of \$0.77, 4/10 of \$0.02
7	7/10 of \$0.40, 3/10 of \$0.32	7/10 of \$0.77, 3/10 of \$0.02
8	8/10 of \$0.40, 2/10 of \$0.32	8/10 of \$0.77, 2/10 of \$0.02
9	9/10 of \$0.40, 1/10 of \$0.32	9/10 of \$0.77, 1/10 of \$0.02
10	10/10 of \$0.40, 0/10 of \$0.32	10/10 of \$0.77, 0/10 of \$0.02

A.7 Instructions for Survey 2

Thank you for completing the first set of experiments. You will next complete another survey. After you complete this next survey, you will complete a second set of experiments. After you complete this second set of experiments, you will be shown a summary screen which will state your bonus based off of your decisions and the computer's random draws. Please click the NEXT button to move to start the survey.

A.8 Survey 2

Complete the questions below. When you are finished, click the NEXT button to move to the next set of questions.
What is your gender?

- Male
- Female

How do you see yourself: Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please tick a box on the scale, where the value 0 means: "risk averse" and the value 10 means: "fully prepared to take risks." You can use the values in between to make your estimate.

Please provide an estimate of the dollar value of your household's total current wealth (including savings and checking account balances, investment accounts, home equity, etc)?

Please provide an estimate of the dollar value of your household's total debt (including housing, credit card, student, and miscellaneous debts)?

[**Barratt Impulsiveness Test**]

Complete the questions below. When you are finished, click the NEXT button to move to the next set of questions.
DIRECTIONS: People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement and click on the appropriate circle on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly. [Answered on scale from 1 to 4 where 1=Rarely/Never, 2=Occasionally,3=Often, and 4= Almost Always/Always.]

I plan tasks carefully.
I do things without thinking.
I make-up my mind quickly.
I am happy-go-lucky.
I don't pay attention.
I have racing thoughts.
I plan trips well ahead of time.
I am self controlled.
I concentrate easily.
I save regularly.
I squirm at plays or lectures.
I am a careful thinker.
I plan for job security.
I say things without thinking.
I like to think about complex problems.
I change jobs.
I act on impulse.

I get easily bored when solving thought problems.
I act on the spur of the moment.
I am a steady thinker.
I change residences. I buy things on impulse.
I can only think about one thing at a time.
I change hobbies.
I spend or charge more than I earn.
I often have extraneous thoughts when thinking.
I am more interested in the present than the future.
I am restless at the theatre or lectures.
I like puzzles.
I am future oriented.

Complete the questions below. When you are finished, click the NEXT button to move to the next set of questions.

People can behave differently in different situations. How would you rate your willingness to take risks in the following areas? Please tick a box on the scale, where the value 0 means: "risk averse" and the value 10 means: "fully prepared to take risks." You can use the values in between to make your estimate.

while driving?
in financial matters?
during leisure and sport?
in your occupation?
with your health?
your faith in other people?

Complete the questions below. When you are finished, click the NEXT button to move to the next set of questions.

Suppose that you are the only income earner in the family. Your doctor recommends that you move because of allergies, and you have to choose between two possible jobs. The first would guarantee you an annual income for life that is equal to your parents' current total family income. The second is possibly better paying, but the income is also less certain. There is a 50-50 chance the second job would double your total lifetime income and a 50-50 chance that it would cut it by a third. Which job would you take - the first job or the second job?

- First job
- Second job
- Do not know

Suppose the chances were 50-50 that the second job would double your lifetime income, and 50-50 that it would cut it in half. Would you take the first job or the second job?

- First job
- Second job
- Do not know

Suppose the chances were 50-50 that the second job would double your lifetime income and 50-50 that it would cut it by seventy-five percent. Would you take the first job or the second job?

- First job
- Second job
- Do not know

Suppose the chances were 50-50 that the second job would double your lifetime income and 50-50 that it would cut it by twenty percent. Would you take the first job or the second job?

- First job
- Second job
- Do not know

Suppose the chances were 50-50 that the second job would double your lifetime income and 50-50 that it would cut it by 10 percent. Would you take the first job or the second job?

- First job
- Second job
- Do not know

Complete the questions below. When you are finished, click the NEXT button to move to the next task that can earn you a bonus.

Suppose that a distant relative left you a share in a private business worth one million dollars. You are immediately faced with a choice - whether to cash out now and take the one million dollars, or to wait until the company goes public in one month, which would give you a 50-50 chance of doubling your money to two million dollars and a 50-50 chance of losing one-third of it, leaving you 667 thousand dollars. Would you cash out immediately or wait until after the company goes public?

- Cash out
- Wait
- Do not know

Suppose that waiting a month, until after the company goes public, would result in a 50-50 chance that the money would be doubled to two million dollars and a 50- 50 chance that it would be reduced by half, to 500 thousand dollars. Would you cash out immediately and take the one million dollars, or wait until the company goes public?

- Cash out
- Wait
- Do not know

Suppose the chances were 50-50 that waiting would double your money to two million dollars and 50-50 that it would reduce it by seventy-five percent, to 250 thousand dollars. Would you cash out immediately and take the one million dollars, or wait until after the company goes public?

- Cash out
- Wait

- Do not know

Suppose that waiting a month, until after the company goes public, would result in a 50-50 chance that the money would be doubled to two million dollars and a 50- 50 chance that it would be reduced by twenty percent, to 800 thousand dollars. Would you cash out immediately and take the one million dollars, or wait until after the company goes public?

- Cash out
- Wait
- Do not know

Suppose the chances were 50-50 that waiting would double your money to two million dollars and 50-50 that it would reduce it by ten percent, to 900 thousand dollars. Would you cash out immediately and take the one million dollars, or wait until after the company goes public?

- Cash out
- Wait
- Do not know

A.9 Investment Task

You are now endowed with 100 cents (i.e., 1 dollar) and are asked to choose the portion of this amount (between 0 and 100 cents, inclusive) that you wish to invest in a risky option. Those cents not invested are yours to keep and will be paid to you by bonus.

If you choose to invest in the option and if the investment is successful, you will receive 2.5 times the amount you chose to invest plus the amount that you did not invest. If the investment is unsuccessful, you lose the amount invested but will still be bonused the amount that you did not invest.

To determine if the investment is successful or not, we will draw a random number between 0 and 1. If the randomly drawn number is less than or equal to .5, the investment is successful. If the random number is greater than .5, the investment is unsuccessful.

We now ask you to indicate the number of cents that you wish to invest:

A.10 Lottery Choice

Below, there are 20 lotteries that vary both by their jackpots (payouts) and their odds (probability of winning). As such, the expected value of the lotteries (probability of wining times the payout) also vary. You are now asked to select which of the lotteries, from the 20 available lotteries, that you would like to play.

After you have chosen your lottery, the computer will randomly draw number between 0 and 1 to determine whether you have won that lottery. If the number drawn is less than or equal to the probability of the lottery winning, then you will win that lottery and earn an additional bonus that is equal to the amount of the payout. If the randomly drawn number is greater than the probability of the selected lottery winning, you will lose the lottery and earn no additional bonus.

So for example, let us assume that lottery X has a probability of winning of 15%, then any number drawn by the computer between 0.00 and 0.15 would win the lottery and any number between 0.16 and 1.00 would not win the lottery.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Prob	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Prize	$5.00	$4.75	$4.50	$4.25	$4.00	$3.75	$3.50	$3.25	$3.00	$2.75	$2.50	$2.25	$2.00	$1.75	$1.50	$1.25	$1.00	$0.75	$0.50	$0.25
EV	$0.25	$0.48	$0.68	$0.85	$1.00	$1.13	$1.23	$1.30	$1.35	$1.38	$1.38	$1.35	$1.30	$1.23	$1.13	$1.00	$0.85	$0.68	$0.48	$0.25
Pick																				

Use the radio buttons below to indicate which lottery you would like to play. When you are done, please click the NEXT Button

A.11 Payoff Screen

Below is a summary of your earnings from each of the experiments you completed. You will be paid the sum of all of your earned bonuses.

GREEN DECISION: The computer selected decision number XXX. The random number that was pulled by the computer is XXX. The computer selected decision XXX. For this decision, you selected Option A. You will be paid a bonus of XXX dollars.

RED DECISION: The computer selected decision number XXX. The random number that was pulled by the computer is XXX. The computer selected decision XXX. For this decision, you selected Option A. You will be paid an additional bonus of XXX dollars.

You invested XXX dollars. The random number draw was XXX which is greater than XXX. Therefore, your earnings for the investment task are XXX dollars.

You selected lottery number XXX. The computer drew XXX which is less than XXX. Therefore, your bonus for the lottery selection task is XXX dollars.

Thanks for your participation! Please submit the HIT!